9-2024

Cucumber mosaic virus and its management in narrow leafed lupins

Department of Primary Industries and Regional Development, Western Australia

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DPIRD-142

Cucumber mosaic virus (CMV) is a seed- and aphid-borne virus that infects narrow-leafed lupins. Western Australian (WA) grainbelt regions most at risk are the high rainfall zones of the northern and central agricultural region and the south coastal region.

The principal infection source for lupin crops is sowing infected lupin seed.

Symptoms

Plant

- Lupin leaves become pale, bunched, and down curled with a faint mosaic pattern.
- All the leaves of seed-infected plants have these symptoms and plants are pale and stunted.
- Plants infected by aphid transmission during the growing season have pale, bunched young leaves with faint mosaic, while older leaves formed prior to infection appear normal. As growth continues, all new leaves show symptoms and the infected plants become stunted.
- The earlier a plant becomes infected, the fewer the pods set, the smaller the size of seed produced, and the smaller the yield.
- With late infection, symptoms are restricted to tip leaves.

Paddock

- Seed-infected plants have leaf symptoms and are pale and stunted and evenly distributed throughout the paddock.
- Plants infected by aphid transmission have pale bunched young growth. They are often affected first and most severely on paddock edges or other bare areas, particularly on the windward side and adjacent to legume pastures. Patches are also common with infection spreading out from the centre.

Image 1: CMV affected lupin plant with characteristic symptoms such as bunched, and down curled leaves

Background – where did it come from?

Sources of virus

- Sowing infected seed produces infected seedlings scattered at random in the crop.
- Aphids pick up the virus from infected plants and spread it to nearby healthy plants.
- When infection incidence reaches 100% in a crop, the maximum possible transmission rate to harvested seed varies with lupin variety.
- In the WA grainbelt, although infected lupin seed is the only cucumber mosaic virus source for lupin crops, other legume hosts, including clovers, chickpea, faba bean, lentil, and field pea can become infected. Weeds that may be affected include capeweed, stagger weed, and fumitory, but the virus is not seed-borne in these species so infection is lost over summer.

Aphid vectors

- CMV is spread by many aphid species, including green peach, blue green, and cowpea aphids that colonise lupins, as well as migrants of common non-lupin colonising species, especially oat, and turnip aphids.
- CMV is transmitted non-persistently: an aphid picks it up within one to 2 seconds of probing an infected plant and transmits it to an uninfected plant in the same timeframe. The virus is then lost once the aphid subsequently probes one or two healthy plants.
- WA grainbelt regions most at risk are the high rainfall zones of the northern and central agricultural region and the south coastal region, due to the increased prevalence of aphid vector populations.

Factors favouring disease risk and spread

- Yield losses can reach 60 per cent (%) when all plants in a crop become infected.
- Losses from cucumber mosaic virus infection are greatest when seed with >1% infection is sown, aphids arrive early, and widespread plant infection occurs.
- The outcome of sowing seed infected with different levels of cucumber mosaic virus varies greatly from year to year and site to site.
- Sowing seed with a high level of infection, which provides many in-crop sources of CMV, together with early arrival of aphids, initiates substantial early epidemics resulting in higher disease incidence, reduced yield, and increased infection in harvested seed.
- By contrast, a dry start to the growing season and sowing seed with a high level of infection results in minimal yield loss and reduction in infection levels in harvested seed. Also, the aphids arrive much later, resulting in significantly reduced CMV spread.

Influence of weather

The date of first arrival of aphids flying from pastures into crops is directly related to the magnitude of rainfall events in late summer and early autumn. Rainfall stimulates plant growth before the growing season, providing hosts (clovers, weeds, and volunteer crop plants) that encourage rapid aphid multiplication.

When lupin crops emerge, aphid flights invade them early and spread cucumber mosaic virus from seed-borne infected seedlings to healthy seedlings, which initiates early spread of cucumber mosaic virus.

When there is little or no summer or autumn rain, few plants are available to support aphids before crops are sown. This means aphid numbers take longer to build up and arrive much later, so cucumber mosaic virus spread starts far later. In low-risk areas, such as low rainfall zones, this scenario occurs more frequently than in high-risk areas.

Yield and quality losses

Yield losses can reach 60% when all plants in a crop become infected.

Sowing seed with a high level of infection, which develops many in-crop sources, together with an early arrival of aphids initiates substantial early epidemics resulting in high disease incidence, reduced yield and increased infection in harvested seed.

Table 1 Effect of sowing cucumber mosaic virus infected seed on yield and subsequent seed transmission (data from department field trials)

Scenario	1	2	3	4
Initial CMV seed infection level	5%	0.5%	5%	0.5%
Aphid arrival	Early	Early	Very late	Very late
Final crop infection	89 to 95%	34 to 53%	1 to 2%	0.1%
Yield loss	36-53%	ns	ns	ns
Harvested CMV seed infection level	12 to 13%	7%	0.6%	0.1 to 0.2%

Key: ns=yield impact is not statistically significant

Monitoring

Test a representative seed sample to determine infection.

Seed infection of <0.1% (a zero result from a 1000 seed test) is recommended for grain crops in high-risk areas, and for seed certification crops in any rainfall zone.

Seed testing can be done through DDLS Seed testing and certification services as a charged service. Call +61 8 9368 3351 or email DDLS Seed testing and certification services for information about plant disease and virus testing, sample submission forms, and sampling techniques.

Integrated disease management strategy

An integrated disease management approach, which uses a range of control measures, is needed to control cucumber mosaic virus in lupin crops:

- Sowing healthy lupin seed is the most important measure.
    - In low-risk areas, seed with < 0.5% infection can be sown without undue risk of yield loss.
    - Seed infection of < 0.1% (a zero result from a 1000 seed test) is recommended for grain crops in high-risk areas, and for seed certification crops in any rainfall zone.
- Sowing varieties with higher levels of resistance to CMV seed transmission will increase the likelihood of lower CMV infection levels in seedlings.
- Sow early at high seeding rates using narrow row spacing to promote early crop canopy coverage. This deters aphids from landing and shades over the seed-infected and early infected plants, denying aphids access to them.
- Direct drill into retained stubble. Groundcover reduces aphid landing rates before a crop canopy develops, especially with wide row spacing.
- Isolate crop from neighbouring lupin crops.
- Maximise weed control. This reduces spread of cucumber mosaic virus from lupins to weeds and then from weeds back to lupins.

Insecticides

Insecticides applied to crops are ineffective at controlling cucumber mosaic virus.

Contact us

Ben Congdon, Grains Senior Research Scientist
+61 8 9368 3499 | Email Ben Congdon

DDLS Seed testing and certification services
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Related content

Visit the department website at dpird.wa.gov.au for more information on:

- Diseases and pests of lupins
- Aphids
- Seed testing
- Western Australian crop sowing guide

Last updated September 2024

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